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(54) Device for determining the location of cooking utensils on a cooking hob comprising discrete distributed heating elements

(57) A device for determining the location of cooking utensils on a cooking hob (1) comprising a plurality of thermal cells (resistors 3, 103) distributed in matrix formation below a heat-resistant surface (2) on which the cooking utensil can be located in random manner, the determination of its location, form and dimensions enabling those thermal cells (3, 103) lying below the utensil to be energized, the same thermal cells (3, 103) being also individually used for this determination

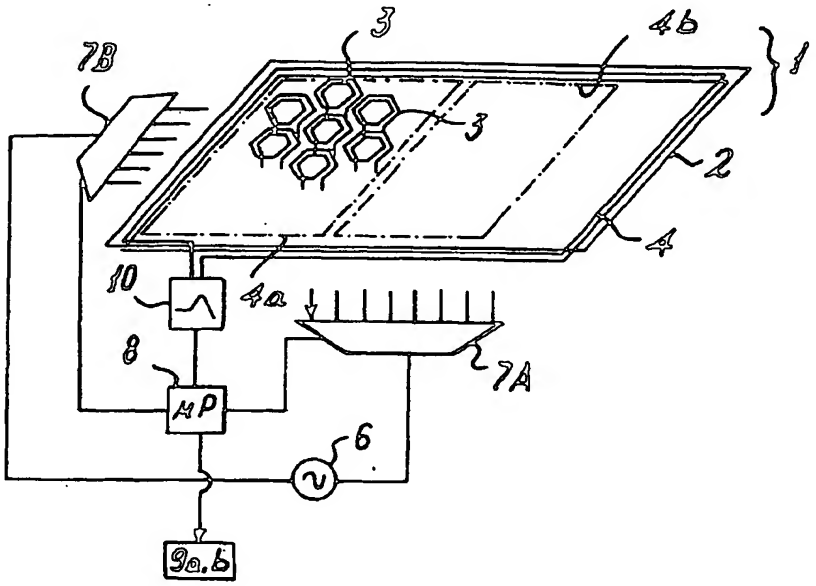

FIG. 1

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Description

[0001] The present inv ntion relates to a device for determining the location of cooking utensils on a cooking hob comprising a plurality of electrically powered thermal cells (resistors) distributed below a heat-resistant surface (for example of glass ceramic) on which at least one cooking utensil for the heat treatment (for example cooking, heating or thawing) of a food contained therein, the thermal cells being disposed in matrix formation, in accordance with the introduction to the accompanying claim 1.

[0002] On these cooking hobs, known as high versatility hobs, the cooking utensil or utensils can be located at any desired point on them, for example depending on the space available, on the user's operating comfort, or even purely randomly. The heating elements which have to be operated depend on the position of the cooking utensil or utensils. Information relative to their position hence constitutes a basic element for the operation of a cooking hob of the considered type.

[0003] IN WO 97/19298, information concerning this position is obtained by means for monitoring the thermal load associated with each of the heating elements. The drawback of such a solution is that it requires electrodes or similar means with relative cabling which, being located in proximity to the heating elements, is subjected to high temperature, to resist which it must be of dedicated type, and hence specific. To this must be added the fact that the large number of components and the complexity of the cabling represent costs which negatively affect the final cost of the product.

[0004] Italian patent application MI200A000926 of 27/4/2000 in the name of the same applicant and relating to a cooking hob of matrix type describes, by way of example, a method for identifying the location of cooking utensils using a video camera which frames the cooking hob, and a touch-screen on which the cooking hob and the cooking utensils disposed on them appear. By touching with the finger the reproductions of these utensils on the screen, the user selects those heating elements underlying the cooking utensils. This although meritorious solution is complex and hence relatively costly besides having the drawback that the video camera is exposed to smoke and steam which can negatively affect its operability.

[0005] An object of the present invention is to provide a device for determining the position, and the form and size (with suitable resolution), of cooking utensils placed on a cooking hob comprising a matrix arrangement of a plurality of heating elements, in order to power those which effectively need to be powered, i.e. those below the utensil, the device being simple, reliable and economically advantageous by comprising components intended for, or already present for, other purposes.

[0006] This and further objects which will be more apparent from the ensuing detailed description are attained by a determination device in accordance with the teachings of the accompanying claims.

[0007] The invention will be more apparent from the detailed description of preferred embodiments thereof given hereinafter by way of non-limiting example and illustrated in the accompanying drawings, in which:

Figure 1 is a basic schematic perspective view of a preferred embodiment of the determination device of the invention;

Figure 2 is a schematic view of the device of the invention with its electrical-electronic circuitry, which also relates to the cooking hob;

Figure 2A shows a practical embodiment of the device of the invention; and

Figure 3 shows the basic scheme of a variant of the invention.

[0008] With reference to the figures, the reference numeral 1 indicates overall a schematically reproduced high-versatility cooking hob which, in conventional manner and as apparent for example from the aforesaid Italian patent application of the same applicant, comprises a conventional glass ceramic plate 2 on which conventional cooking utensils (saucepans, pans, frying pans, etc.) rest. Below the plate there are provided a plurality of heating elements 3, represented by metal resistors disposed for example in spiral arrangement, distributed such as to overall cover the maximum useful surface of the glass ceramic plate 2. The heating elements are arranged in matrix formation (as best seen from Figure 2), of which conceptually each heating element can be considered an individually energizable "thermal cell", by which definition, i.e. "thermal cell" they will be identified hereinafter.

[0009] Groups of cells 3 can be energized, where each group is dedicated to a different specific cooking utensil based on its peripheral outline, as described for example in the aforesaid Italian patent application in the name of the same applicant.

[0010] In the embodiment of Figures 1, 2 and 2A of the present invention, the location of the cooking utensil or utensils, for the purpose of selecting the heating elements to be made operative, is determined using the thermal cells 3 themselves to obtain an electromagnetic coupling with a separate means 4 formed from one or more conductive loops which, in a certain sense and in this example, surround the thermal cells overall. As is evident, the scope of the invention also includes the solution comprising groups of loops, each surrounding an assigned subassembly of thermal cells, for example as illustrated in Figure 1 with dashed and dotted lines and carrying the reference numerals 4a and 4b.

[0011] Each thermal cell, connectable to the power source 10A via (Figure 2) static switches 9 program-controlled by a microprocessor 8, for xample in accordance with the method stated in the aforesaid Italian patent application of th same applicant, can also be connected to an alternating signal source 6 via column se-

lectors 7A and row selectors 7B (for example r presented by multiplexers) both controlled by said microprocessor 8 such that the signal of the sourc 6 is applied, in cyclic succession, to different thermal c lls 3. The signal received by the loops 4 is different depending on whether a cooking utensil lies on a thermal cell receiving the signal of the source 6.

[0012] If a utensil is present, the electromagnetic coupling between the thermal cell 3 and the loop 4 undergoes a variation. The variation is measured by a circuit 10 (for example comprising a band pass filter. amplifier, double half wave rectifier, envelope detector) the output of which reaches the microprocessor 8 via an A/D converter (not shown). The microprocessor associates this signal variation with the presence/absence of the cooking utensil on the specific thermal cell which has produced it and effects such an association for each thermal cell on which the cooking utensil lies, and builds a memory map containing the overall the measurements relative to each cell. A suitable algorithm extracts from this map those thermal cells to be energized (via the static switches 9). The said mapping can be for example also used to display on a light-emitting panel the location of cooking utensils on the hob. It should be noted that in a preferred embodiment of the invention the thermal cell selection (for the purpose of applying to it the alternative signal of the source 6) takes place while the relative row and column are not powered with mains voltage via the aforesaid static switches 9. In other words, the said algorithm (or another) coordinates the sequence in which the thermal cells 3 are powered by the power source 10A (via the static switches 10A) with the sequence of selection operated via the multiplexer 7A, 7B.

[0013] Figure 2 schematically shows the matrix formation of the thermal cells 3 of a cooking hob and the static switches 9 (9a for rows and 9b for columns, here exemplified as triacs) provided for energizing the selected thermal cells 3 via diodes 11. The energy is supplied by the unfiltered full-wave rectified electrical source 10A, in accordance with the preceding patent of the same applicant.

[0014] In the aforegoing it has been stated that the signal for determining the absence/presence of the cooking utensil is applied to the thermal cells 3 which hence act as a "transmitter" whereas the loops act as a "receiver" for the signal emitted by the cell itself. It is however evident that the scope of the invention includes the dual solution, in which the loops 4 act as the transmitter and the thermal cells 3 as the receiver. In this solution the loops 4 can be excited continuously or discontinuously (for example at predetermined intervals), the thermal cells 3 being enabled cyclically on receiving the signal during excitation of the loops 4.

[0015] Figure 2A represents a practical embodiment of the invention. This figure uses the same alphanumerical references as the preceding figures to indicate equal or corresponding parts. Here, ach row switch 12b consists of an NPN transistor with its emitter earthed and a diode connected to the collector to which a positive source is connected via a resistor, whereas the column switch 12a consists of an NPN transistor with its emitter earthed, its collector connected to a positive source via a resistor and to the base of a PNP transistor with its collector connected to earth via a resistor and to a column diode, its emitter being connected to a positive source. The purpose of the diodes is to protect against overvoltage. In this embodiment the row concerned is connected to earth while the column concerned is driven or is in alternating current (or vice versa).

[0016] The embodiment of Figure 3 in which equal or corresponding parts are indicated by the preceding reference numerals plus 100, the thermal cell 103 itself constitutes an integral part of an oscillator 20 when a switching means (for example a triac), indicated by 21 and controlled by the microprocessor 108 is driven by this latter into the logic position A by which it is connected to the remaining part 20a of the oscillator, the oscillator being connected to a rectifier 20b and this to an integrator 20c. The d.c. output indicated by 20d passes to the microprocessor 108. If a cooking utensil is located on the thermal cell the oscillator characteristic varies, this variation acting on the microprocessor 108 in the sense of causing the switch 21 to assume the logic position B in which the thermal cell is connected to the power source 110A which energizes it, in accordance with the algorithm indicated in the said patent application in the name of the same applicant, which algorithm by imposing energization cut-out and application stages causes the switch to pass (during cut-out) to a floating position indicated by C. The switch 21 evidently represents a function and not the specific solution, which is obviously represented by electrical/electronic means implementing the described function.

[0017] Although the embodiment of Figure 3 refers to a single thermal cell, it will be evident to the expert of the art how to adapt it to the plurality of thermal cells forming the cooking hob 1.

[0018] The sensing part shown in Figure 2 comprises the alternating signal source 6, associated with a direct current offset 13 (by which the signal of the source 6 passes all positive) and the selectors (multiplexers 7A, 7B) reproduced in the form of physical switches 12a and 12b, as means which cyclically provide a pulse signal to the individual thermal cells 3, as stated hereinbefore.

[0019] The source 6 can be square wave and have a frequency of 80 kHz.

Claims

1. A device for determining the location of cooking utensils on a cooking hob (1) comprising a plurality of thermal cells (resistors 3, 103) distributed in matrix formation below a heat-resistant surface (2) on which the cooking utensil can be located in random

manner, th determination of its location, form and dimensions enabling those thermal cells (3, 103) lying b low the utensil to be energized, **characterised in that** the same thermal cells (3, 103) are also individually used for this determination.

2. A device as claimed in claim 1, wherein the thermal cell (3) acts as a transmitter of electromagnetic signals which are received by an electromagnetically coupled receiver means (4), and of which the content varies according to whether or not the cooking utensil is located on the thermal cell, said variation being used for the energization of the cell.

3. A device as claimed in claim 1, wherein the thermal cell (3) acts as a receiver of electromagnetic signals which are transmitted by said electromagnetically coupled receiver means (4), and of which the content varies according to whether or not the cooking utensil is located on the thermal cell, said variation being used for the energization of the cell.

4. A device as claimed in claims 1 and 2 or 1 and 3, wherein the receiver/transmitter means (4) is formed of at least one loop surrounding at least a part of the thermal cells present.

5. A device as claimed in one or more of the preceding claims, wherein means (7A,B; 121a,b) are provided for the cyclic selection of the individual thermal cells (3) for the purpose of determining the presence of the cooking utensil.

6. A device as claimed in one or more of the preceding claims, wherein electronic selection means (8, 108) are provided for the energization of the thermal cell and for the determination function thereof.

7. A device as claimed in claim 6, wherein the determination function is alternated with that of energization.

8. A device as claimed in one or more of the preceding claims, wherein the thermal cell (103) forms part of an oscillator (20) during the determination of the cooking utensil.

9. A device as claimed in one or more of claims from 1 to 7, wherein for determination purposes, electronic switch means (12a. 12b) (Figure 2A) are provided which connect selectively to earth the rows of the matrix distribution of thermal cells (3) and, respectively, enable the columns of the matrix distribution of thermal cells to be selectively driven with an alternating signal (or vice versa).

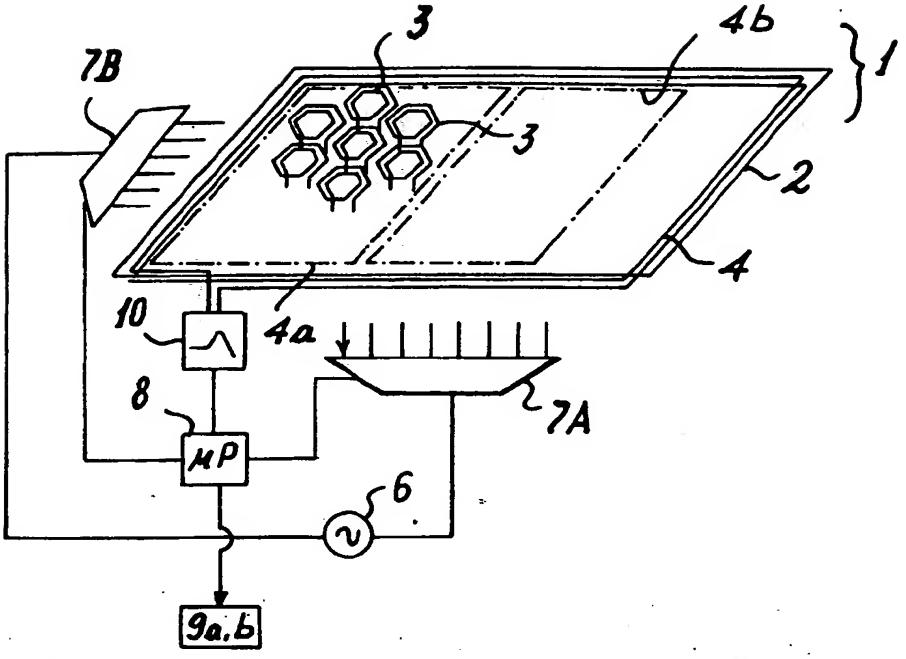
3
4b
1
7B
3
2
4
10
4a
8
7A
μP
6
9a,b

FIG. 1

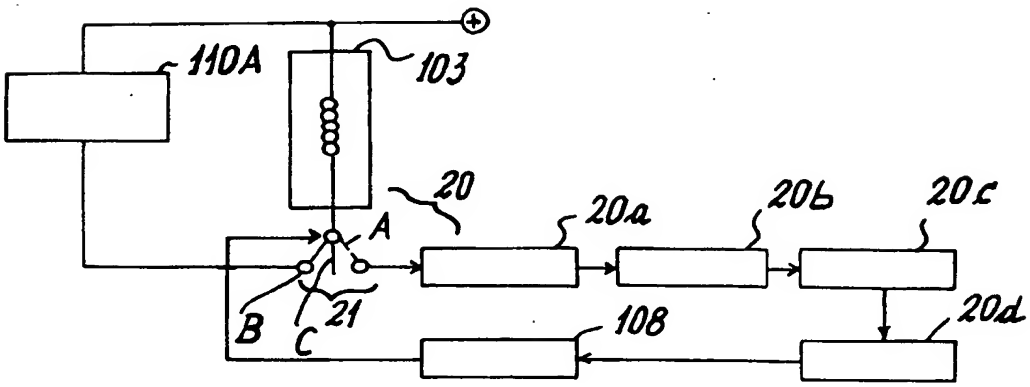
110A
103
20
20a
20b
20c
A
B
C
21
108
20d

FIG. 3

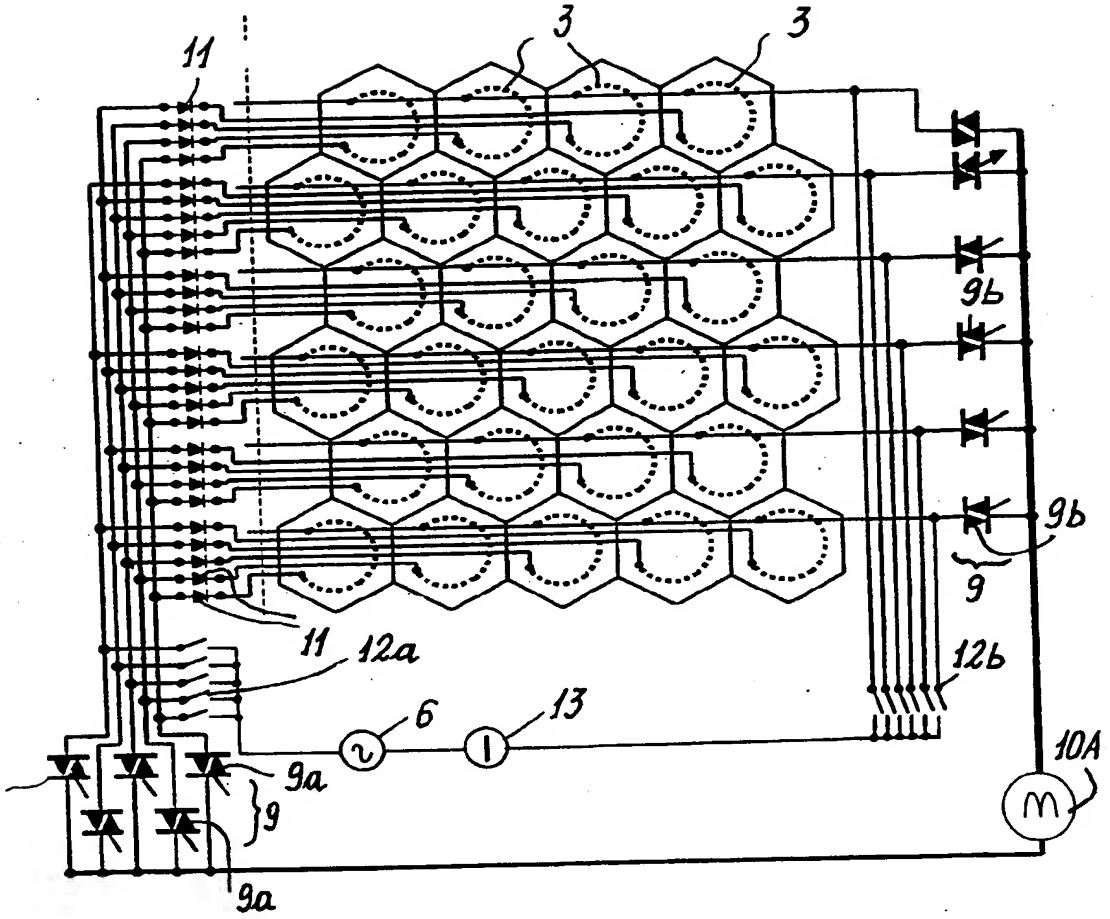

FIG. 2

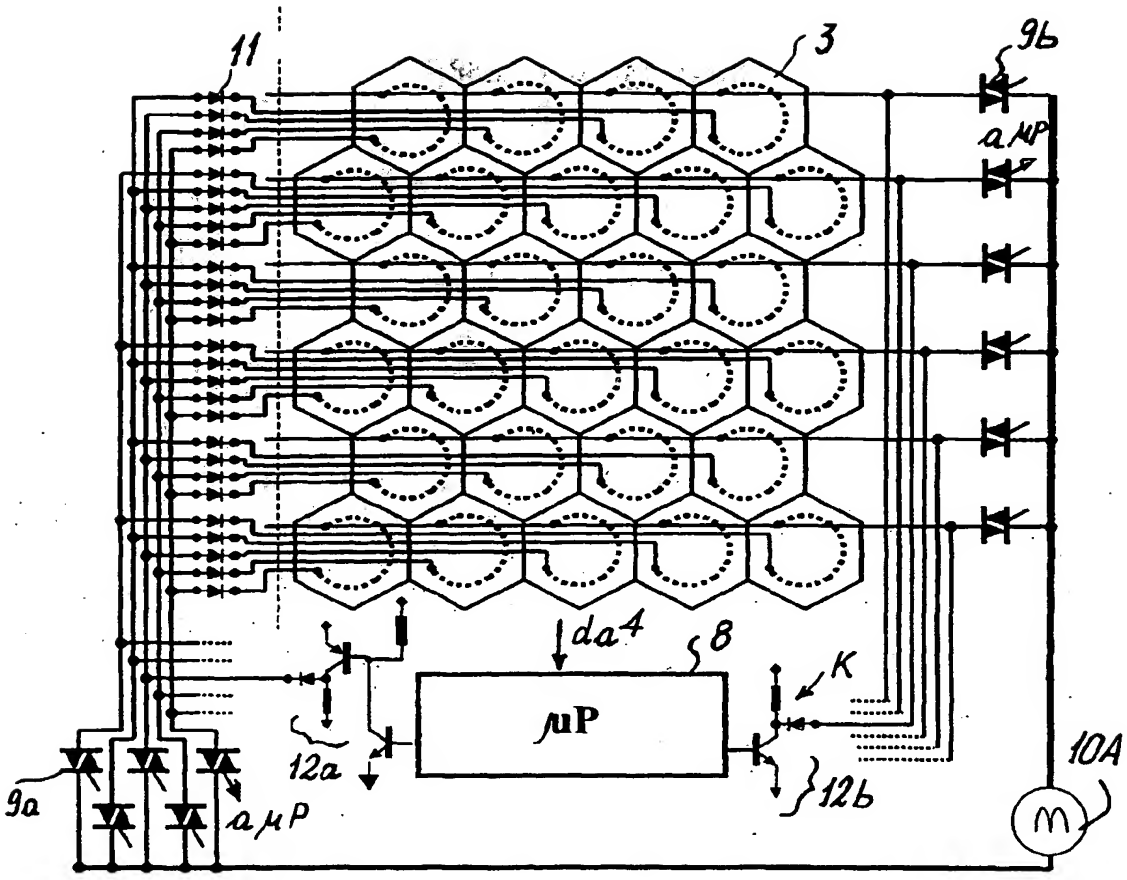

FIG. 2A